

# Landsat

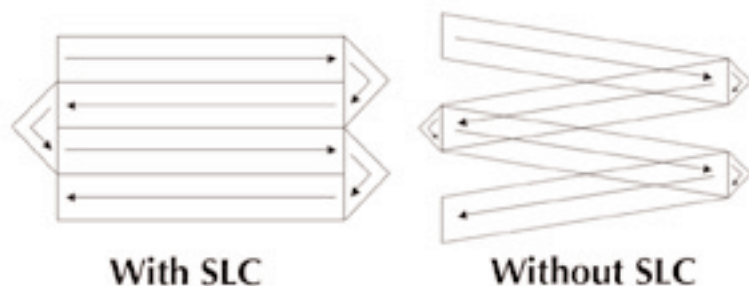
## Program Update

**L A N D S A T**  
*Providing space-based observations of  
 Earth since 1972*

July 23, 2002 was the 30th anniversary of the launch of the first of a series of Landsat satellites that have continuously supplied the world with global surface images. Landsat 5, launched in 1984, continues to provide important observations of the landmass of the planet, and has established a record for reliability in the civilian space fleet. Landsat 7 joined Landsat 5 in global observations in 1999. Both Landsat 5 and Landsat 7 provide data for remote sensing and GIS science and applications around the world.

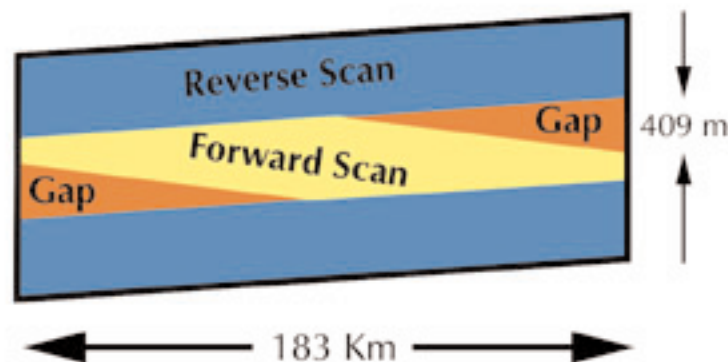
For four years, the two earth observing satellites provided extensive, frequent coverage. In late May 2003, Landsat 7's Enhanced Thematic Mapper Plus (ETM+), suffered the loss of its scan line corrector (SLC) mechanism. By mid-July 2003 the ETM+ resumed its global land survey mission resulting in only a six-week gap in contributing imagery to the U.S. archive. However, the malfunction has had an impact on the imagery from Landsat 7.

The ETM+ optics contain the Scan Mirror and Scan Line Correction Assembly among other components. The Scan Mirror provides the across track motion for the imaging, while the forward velocity of the spacecraft provides the along track motion. The Scan Line Correction Assembly (SLC) is used to remove the 'zig-zag' motion of the imaging field of view produced by the combination of the along and across track motion. Without an operating SLC, the ETM+ line of sight now traces a zig-zag pattern across the satellite ground track (Fig. 1).



**Fig. 1**

In this SLC-Off mode, the ETM+ still acquires approximately 75 percent of the data for any given scene. The gaps in data form alternating wedges that increase in width from the center to the edge of a scene (Fig.2).



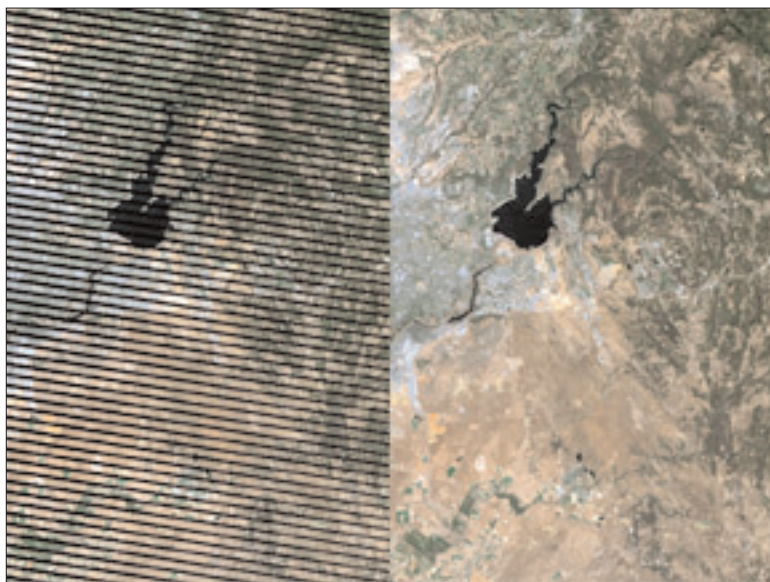
**Fig. 2**

The remainder of the ETM+ sensor, including the primary mirror, continues to operate, radiometrically and geometrically, at the same high-level of accuracy and precision as it did before the anomaly; therefore, image pixels are still accurately geolocated and calibrated.

### **The Landsat 7 ETM+ system continues to produce high-quality data of the Earth's land areas.**

To fulfill the expectations of the user community for full coverage single scenes, data from multiple acquisitions are being merged to resolve the SLC-off data gaps. The first of these products is now available from the USGS EROS Data Center. In this Phase I release, the gaps in a current SLC-off scene are filled with data from a normal SLC-on scene that was acquired approximately one year earlier (i.e., during the same plant phenological stage if possible). The two scenes are geometrically registered, and a histogram matching technique is applied to the fill pixels that provide the best-expected radiance values for the missing data. The new product represents an effort by the USGS Landsat 7 Project at the EROS Data Center in Sioux Falls, South Dakota to increase the utility of the Landsat 7 Enhanced Thematic Mapper Plus (ETM+) data affected by the non-functional scan line corrector.

The Phase II release, targeted for early 2005, will consist of a more advanced product that merges data from multiple SLC-off scenes acquired within weeks of each other. In all cases, a binary bit mask will be provided so that the user can determine where the data for any given pixel originated. The USGS is continuing to research other methods of providing better merged data products, and will continue to provide information resulting from this work as it becomes available.



**Fig. 3** Example of Phase II gap-filled data product. This figure contrasts a small portion of a Landsat 7 scene featuring Folsom Lake, CA (WRS-2 Path 43 Row 33). The image on the left was acquired on August 12, 2003; the image on the right is the resulting Phase II gap-filled product using the August 28, 2003 acquisition to fill the gaps.

Further information and product samples of the new gap-filled Landsat 7 data can be found at the following website:  
[http://landsat7.usgs.gov/slc\\_enhancements/gapfilled1.php](http://landsat7.usgs.gov/slc_enhancements/gapfilled1.php)

For information on all Landsat data products, visit the Landsat Data Products Web Page at <http://landsat7.usgs.gov/dataprod.php>

## The Future of Landsat

Efforts to begin implementing a successor mission to Landsat 7, called the Landsat Data Continuity Mission (LDCM), suffered a setback in 2003. Landsat Program Management (NASA and USGS) had planned to purchase data meeting LDCM specifications from a privately owned and commercially operated satellite system beginning in March 2007. NASA, however, cancelled a Request-for-Proposals (RFP) for providing the required data after an evaluation of proposals received from private industry. Alternative strategies for implementing an LDCM are now under consideration.

The Executive Office of the President formed an interagency working group on the LDCM following the RFP cancellation. The working group is considering other options for implementing a successor system to Landsat 7 consistent with the Land Remote Sensing Policy Act of 1992 (Public Law 102-555). This Act lists four management options for consideration: 1) private sector funding and management; 2) an international consortium; 3) funding and management by the U.S. Government; and 4) a cooperative effort between the U.S. Government and the private sector. The working group is currently attempting to minimize the risk of a Landsat data gap through development of a strategy that leads to a Landsat 7 successor mission.

## 30+ Years of Landsat Data are available through USGS

To search for data, please visit the EarthExplorer or GloVis website:

EarthExplorer <http://earthexplorer.usgs.gov>

GloVis <http://glovis.usgs.gov>

### Data are no longer available at the EOSDIS Gateway

Although the method of data access will change, there will be no other change to the processing or format of the products. Level 1 and Level 0 products that were available through the EDG will now be orderable through the USGS Earth Explorer and the Global Visualization Viewer (GloVis), and processing will be done by the same systems currently in use (LPGS and NLAPS).

Landsat 5 data cost \$425 per scene (for Level 1G processing)  
 Landsat 7 data acquired prior to the SLC malfunction cost \$600 per scene (for Level 1G processing)

The U.S. Geological Survey (USGS) has reduced the price of Landsat 7 scenes with gaps in data resulting from the SLC failure. Scenes that contain gaps in data have been reduced from \$600 to \$250.

Scenes with the gaps filled-in using data acquired prior to the anomaly are also offered at a reduced price of \$275 as of May 10, 2004. This product will have the gap areas filled in with Landsat 7 data acquired prior to the scan line corrector (SLC) failure at a similar time of the year.

**The Landsat Project is a joint initiative of the National Aeronautics and Space Administration (NASA) and the U.S. Geological Survey (USGS) to gather Earth resource data using a series of satellites. NASA was responsible for developing and launching the spacecrafts, while the USGS is responsible for flight operations, maintenance, and management of all ground data reception, processing, archiving, product generation, and distribution.**

